

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

REC'D 13 DEC 2005

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| Applicant's or agent's file reference P64129PC00 | FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/PEA/416) | |
| International application No. PCT/NL2003/000819 | International filing date (day/month/year) 21.11.2003 | Priority date (day/month/year) 21.11.2003 |
| International Patent Classification (IPC) or both national classification and IPC G02B26/08 | | |
| Applicant NEDERLANDSE ORGANISATIE VOOR TOEGEPAST..et al. | | |

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 5 sheets, including this cover sheet.
 - ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 3 sheets.

3. This report contains indications relating to the following items:
 - I ☒ Basis of the opinion
 - II ☐ Priority
 - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
 - IV ☒ Lack of unity of invention
 - V ☒ Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
 - VI ☐ Certain documents cited
 - VII ☐ Certain defects in the international application
 - VIII ☐ Certain observations on the international application

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| Date of submission of the demand 21.06.2005 | Date of completion of this report 12.12.2005 |
| Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465 | Authorized Officer Daffner, M Telephone No. +49 89 2399-7087  |

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**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. **PCT/NL2003/000819**

I. Basis of the report

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):

Description, Pages

1-10 as originally filed

Claims, Numbers

1-12 received on 21.06.2005 with letter of 21.06.2005

Drawings, Sheets

1/2, 2/2 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).
3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:
- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:
- ☐ the drawings, sheets:

**INTERNATIONAL PRELIMINARY
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International application No. **PCT/NL2003/000819**

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

IV. Lack of unity of invention

1. In response to the invitation to restrict or pay additional fees, the applicant has:

- ☐ restricted the claims.
☒ paid additional fees.
☐ paid additional fees under protest.
☐ neither restricted nor paid additional fees.

2. ☐ This Authority found that the requirement of unity of invention is not complied with and chose, according to Rule 68.1, not to invite the applicant to restrict or pay additional fees.

3. This Authority considers that the requirement of unity of invention in accordance with Rules 13.1, 13.2 and 13.3 is

- ☐ complied with.
☐ not complied with for the following reasons:

4. Consequently, the following parts of the international application were the subject of international preliminary examination in establishing this report:

- ☒ all parts.
☐ the parts relating to claims Nos. .

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

| | | |
|-------------------------------|-------------|------|
| Novelty (N) | Yes: Claims | 1-12 |
| | No: Claims | |
| Inventive step (IS) | Yes: Claims | 1-12 |
| | No: Claims | |
| Industrial applicability (IA) | Yes: Claims | 1-12 |
| | No: Claims | |

2. Citations and explanations

see separate sheet

The examination is being carried out on claims 1- 12 as filed with letter of 21.06.05.
The documents referred to in the examination are numbered in the order of citation in the search report.

Re Item IV

Lack of unity of invention

1 As already discussed in the additional sheet of the international search report group 1, comprising claims 1-9 and group 2, comprising claims 10 - 12 are not unitary for the following reasons:

1.1 Independent claims 1 and 10 do not define any common special technical features.

1.2 Furthermore, said claims do not define any corresponding technical features. Evidence for this view is found on page 9, line 29 to page 30, line 11 of the description since it is stated that the support construction defined in claim 11 is not necessarily intended for the use in a deformable membrane mirror according to claim 1.

Claims 1-9 define a deformable membrane mirror.

Claims 10 - 12 define a support structure.

1.3 In addition the above defined groups are related to different technical problems:-

1.3.1 The problems to be solved by the first invention is to deform a membrane without introducing lateral stress as apparent e.g. from page 3, lines 11 - 18 of the description.

1.3.2 The problem to be solved by the second group of claims is to avoid deformation of a support structure due to inhomogen heating.

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

2 The surface actuation structure defined in claim 1 is novel and inventive.

Magnetic surface deformation actuation structures are e.g. known from documents D1 - D7.

However none of the documents contains a hint towards an actuator array formed of cells with variably magnetizable walls and a variably magnetizable resilient surface.

3 Claims 2 - 9 are dependent on claim 1 and as such also meet the requirements of the PCT with respect to novelty and inventive step.

4 The second independent Claim 10 is unclear for the following reasons.
The expressions 'support plate' and 'support structure' are vague.
The features of the 'rod shaped connection elements' are unclear since the expression 'leaving space to permit air to circulate' is vague and the expression 'having anisotropic stiffness [...], without opposing transverse relative movement between the support structure and the support plate' merely appears to define an isostatic mount.

However, a clarified claim 10 would appear to be novel and inventive since there is no hint in the prior art towards e.g. a honeycomb structure as e.g. defined in claim 11 allowing air circulation or thermal isolation as defined in claim 12.

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Int. pat. appln. no. PCT/NL2003/000819
Our letter of June 21, 2005

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(44)

Amended claims

1. A surface deformation actuation structure, comprising
 - a deformable membrane that has a first surface and a second surface opposite said first surface;
 - an array of actuators located facing the second surface, each actuator having an actuating surface, each actuator being arranged to actuate displacement of the actuating surface substantially perpendicularly to the second surface;
 - an array of actuating connections, each coupled to the actuating surface of a respective one of the actuators in the array and a respective point of the second surface substantially opposite the actuating surface, each actuating connection having anisotropic stiffness, substantially transmitting movement perpendicular to the second surface and leaving planar displacement and/or local rotation of the second surface substantially free, the array of actuators comprising
 - a variably magnetizable base plane,
 - an array of variably magnetizable islands on said base plane;
 - actuator coils, each running around a respective one of the islands;
 - a system of variably magnetizable walls on the base plane, the walls dividing a surface of the base plane into separate cells, each containing a respective one of the islands and coils;
 - a variably magnetizable resilient surface, with surface parts that each rest on at least one of the walls of respective cells, extend over a respective one of the islands and contain a respective one of the actuating surfaces.
2. A surface deformation actuation structure according to claim 1, comprising permanent magnets placed on top of the islands.

3. A surface deformation actuation structure according to claim 1, wherein the array of actuators comprises a support plate and the surface deformation actuation structure comprises

- a support structure, and
- an array of rod shaped connection elements connecting the support structure and support plate, leaving space to permit air to circulate between the support structures and the support plate, each connection element having anisotropic stiffness, substantially limiting a maximum distance between the support plate and the support structure to a predetermined value, without opposing transverse relative movement between the support structure and the support plate.

4. A surface deformation actuation structure according to claim 3, wherein the support structure comprises a honeycomb structure with cells that extend perpendicular to the support plate, and wall segments surrounding the cells at least in planes perpendicular to the support plate, the connection elements connecting junctions of wall segments to the support plate.

5. A surface deformation actuation structure according to claim 4, comprising thermal isolation material between the wall segments and inner spaces of the cells, the cells being open to permit air circulation from and/or to the support plate through the cells.

6. A surface deformation actuation structure according to claim 1, wherein the first surface is an optical mirror surface.

7. A surface deformation actuation structure according to claim 1, wherein each actuation connection is rod shaped and at least ten times longer perpendicular to the second surface than wide.

8. A surface deformation actuation structure, according to any one of the preceding claims comprising

- a variably magnetizable base plate,
- an array of variably magnetizable islands on said base plate;
- actuator coils, each running around a respective one of the islands;

- a system of variably magnetizable walls on the base plate, the walls dividing a surface of the base plate into separate cells, each containing a respective one of the islands and coils;
- a variably magnetizable resilient surface, with surface parts that each rest on at least one of the walls of respective cells, extend over a respective one of the islands and contain a respective one of the actuating surfaces.

9. An actuator array according to Claim 8 comprising permanent magnets placed on top of the islands.

10. A support construction; comprising

- a support plate;
- a support structure; and
- an array of rod shaped connection elements connecting the support structure and support plate, leaving space to permit air to circulate between the support structures and the support plate, each connection element having anisotropic stiffness, substantially limiting a maximum distance between the support plate and the support structure to a predetermined value, without opposing transverse relative movement between the support structure and the support plate.

11. A support construction according to claim 10, wherein the support structure comprises a honeycomb structure with cells that extend perpendicular to the support plate, and wall segments surrounding the cells at least in planes perpendicular to the support plate, the connection elements connecting junctions of wall segments to the support plate.

12. A support construction according to claim 10, comprising thermal isolation material between the wall segments and inner spaces of the cells, the cells being open to permit air circulation from and/or to the support plate through the cells.